

# Metallic Cartridge Re-loading.

## Some points to consider.

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Many acquaintances have expressed an interest in re-Loading, ideally these people would have a friend or mentor to guide them but sadly this is not always the case and they attempt to figure things out for themselves. This is not usually a problem if they have an engineering background but otherwise it can be daunting.

This document is based on my practical experience, errors I have made and anecdotal reports from friends. If you would like to add to this document, whether anonymously or openly; then please feel welcome to do so.

Any contributions that increase knowledge and awareness will be gratefully received.

Disclaimer:

This document is not intended to be an authoritative treatise on the art of re-loading. Rather it is intended to:

- Assist those who are thinking of dabbling in the Black Art of re-loading
- Pass on aspects of practical experience warts and all from myself and others.
- Highlight risks.
- Introduce the reader to various aspects of terminology and equipment.
- Provide an introduction to the process and guide the reader to further sources.

**This document is a guide and as I have no control over how the information is interpreted, or the procedures used during the reloading process, I accept no responsibility for any accidents that may occur by using this information.**

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## Why Re-load?

There are various reasons for re-loading and some of us have more than one driver. Typical reasons include:

- Cost – home loaded ammunition is cheaper than “Factory Ammo” from the gun shop and makes the hobby of shooting more affordable.
- Flexibility – gun shops are commercial enterprises and stock the most popular calibres and weights. You may want to use a rare calibre or an uncommon weight and re-loading may be your only option.
- Accuracy – Factory Ammo is consistent but no two guns are the same, even consecutive guns off the same production line will differ and whilst your friend may shoot ½” groups at 100 yards, your identical gun with the same ammo only achieves 2” groups.
- Inquisitiveness – Why do these people re-load, could I do it, what’s it all about? In other words a practical or academic interest.

It is illegal to manufacture ammunition for sale to others unless you are licensed to do so.

Never accept someone else’s re-loads; they may not have taken the necessary care.

Get a re-loading manual if you want to experiment with downloads or anything other than standard re-loading. It would be dangerous to deviate from the guidance in the manual.

Do not reload anything that is not on your FAC, you will be committing an offence.

## What can I Re-load?

Obviously the “Muzzle Stuffer” is practising the art of re-loading for each shot whereas those using cartridges are using predetermined loads. Shotgun cartridges can be re-loaded but that is outside the scope of this document. So what types of metallic cartridges are there and can they be re-loaded?

- Rimfire – by the nature of their construction, rimfire cartridges do not lend themselves to re-loading. I have known lunatics who have pulled .22 LR cartridges and re-loaded them with bigger charges. This must be condemned as they are producing rogue loads; the gun could explode on firing resulting in death or injury to both the shooter and innocent parties on the firing point. Don’t do it!
- Pistol Calibres – many of us use pistol calibre carbines such as .38 Special and .357 Magnum. These can easily be re-loaded and provide an economical approach to shooting these popular rounds.
- Black Powder (BP) – Reproduction Black Powder firearms such as the “Yellowboy” and calibres such as 45-70 and 45-120 where early cartridge examples but use BP as opposed to modern smokeless nitro powders.
- Modern Rifle – this covers all rifles using nitro powder ammunition such as .303, 7.62/.308, .223 and the wealth of modern calibres available to shooters today.

There is plenty of scope for the re-loader but the secret is to how to do it safely?

## What are the components for Re-loading?

Reloading components are available from gun shops, increasingly you will be asked to show your FAC when buying components even though the law does not always require this.

### Powder Storage

Explosives legislation covers explosives articles and substances that are used in sporting and leisure activities - primarily competition shooting and also in the use of firearms (including cannons) at re-enactments of historic battles: <http://www.hse.gov.uk/explosives/information/shooting.htm>

You can store a limited quantity of certain explosives without a registration or licence. For the types of explosives used by shooters and re-enactors the maximum quantities of explosives that can be stored without a licence or registration are:

- 15kg of percussion caps and/or small arms ammunition;
- 10kg of gunpowder (black powder, UN number 0027), and
  - a further 5kg of any one or more of the following:
    - gunpowder,
    - smokeless powder
    - any explosive listed on Schedule 1 of the Control of Explosives Regulations 1991. This includes the articles listed in the table below.

Explosives	U.N. no.
Cartridges small arms	0012
Cartridges small arms	0328
Cartridges small arms	0339
Cartridges small arms blank	0014
Cartridges small arms blank	0327
Cartridges small arms blank	0338
Cases cartridges empty with primer	0055
Cases cartridges empty with primer	0379
Primers cap type	0044
Primers cap type	0377
Primers cap type	0378

### MSER extract

The following paragraphs are extracted from the currently available MSER guide which you are strongly advised to obtain from the BASC website. The guide also provides the specifications for a wooden storage box.

#### Storage of Black Powder.

All dangerous substances are classified by a United Nations system. Explosives are categorised as Class 1. MSER allocates "Hazard Types" to all explosives categorised as UN Class 1. Hazard types range from 1 to 4, and those types are generally defined by the behaviour of the explosive when it functions during any process of manufacture and storage.

Black powder is classed as Hazard Type 1. All Hazard 1 material has a separation distance\* applied when stored. Schedule 2 of MSER lists separation distances to be applied to the stored explosive, dependant on the type and quantity.

*\* Separation distances are used to keep explosive stores away from other buildings. It is a complex system designed for safety.*

*Note: Separation distance does NOT apply to hazard type 1 powder if ACoP paragraphs 410-420 are applied i.e. if they are stored in a suitable wooden, partitioned box. Powder should also be stored in their original supplied containers/packaging and with no greater than 550 grams per container (approx 1 ¼ lb). A temporary exemption does exist (or did at June 2009) for 1kg (non metal) containers until manufacturers and suppliers change their packaging.*

### **Storing Nitro-cellulose based powders.**

Nitro-cellulose propellants are usually hazard type 3. No separation distance applies for stores of powder less than 25kg\*. A home loader does not need to comply with the ACoP paragraphs 410 - 420 i.e. does not have to store nitro-cellulose propellants in a partitioned wooden box so long as he is storing LESS than 25Kg.

*\* However your premises must be registered with the police for storage of nitro powder over 5 kg.*

### **Mixed Storage Nitro-cellulose based powders with black powder and other propellants**

The regulations state - *Where explosives of different hazard types are in one store, the explosives shall be treated as belonging to the greater hazard type requiring the greatest separation distance for the total quantity of those explosives and the separation distance shall be determined in relation to that total quantity.*

i.e. the storage together of hazard type 3 nitro powders with any black powder (a hazard type 1 explosive) would cause the nitro powders to be classed also as hazard type 1 and would have to be stored in line with the ACoP i.e. by use of the wooden box storage.

If you store your black powder in a wooden box in one area of your premises and your nitro powder in another storage area/room separately from the black powder, this will be sufficient to negate the requirement to combine storage of both black (HT1) and nitro-cellulose based (HT3) powders in the wooden box.

## **Powders**

There is a wide range of re-loading powders but basically they fall into 3 categories:

1. Black Powder – the original gunpowder or a modern synthetic alternative such as “Pyrodex”. Please note you will require an Explosives Certificate to buy and store BP. You will also require a “Recipient Competent Authority” (RCA) to transport Black Powder from gun shop to home and from home to range as well as a BP storage box built to current Health and Safety Executive standards, see MSER 2005 guidance. Black Powder is available in various grades to suit pistols, rifles and frizzen pans for flintlocks.
2. Pyrodex and Triple 7– are alternatives to Black Powder and also available in various grades, but with slightly different combustion characteristics. They are intended to be used at the same volume as there Black Powder equivalent. N.B. it is not a weight for weight equivalent. Unlike Black Powder, these alternatives are not classed as Type 1 Hazard explosives. Guidance notes and loading data is available from the manufacturers’ website at <http://www.hodgdon.com/pyrodex.html>
3. Pistol Powders – these are comparatively fast burning nitro powders due to the need to develop maximum pressure within the relatively short overall length of a pistol barrel. On no account

should pistol powders be used to re-load a rifle cartridge. You will probably blow up your gun and cause death or injury.

4. Rifle Powders – these are comparatively slow burning nitro powders designed to accelerate the bullet to maximum velocity over the length of a rifle barrel.

Never use modern Pistol or Rifle powders when reloading for a BP weapon. You and others will probably lose bits of your anatomy.

### Cases:

Obviously you need a cartridge case, these can be recycled Factory Ammo or bought in bulk from one of the many suppliers.

It is imperative that you inspect all cases before you start. The heat and pressure of shooting causes the case neck to harden and splits may form. Some re-loaders anneal their cases to minimise the risk of hardening and cracking but this practice is outside the scope of this document. Further information on annealing is available at <http://www.6mibr.com/annealing.html>

Any case with splits around the neck, signs of stretching or excessive pressure must be binned.

### Primers

The next component is the “Primer” which sits in the base of the case and when struck by the firing pin generates a flash of flame to ignite the main charge. Primers come in a variety of sizes and types e.g. pistol, small rifle, large rifle and magnum.

Primers are categorised by their “brisance”... how hot they are. Only use primers specified in the reloading data, a magnum primer is for slow burning bulky charges only, using a magnum primer in place of a standard primer will probably blow the gun up.

Boxer primers have an internal anvil against which the flash is generated and the flash subsequently passes through the central flash hole in the base of the cartridge. Burdan type primers sit over a central anvil in the base of the case and there are two flash holes either side of the centre line through which the flame travels. Burdan primed cases require specialist equipment to de-prime.

You must not use modern primers in a Burdan case, be sure to use the right sort of primer.

One acquaintance decided he could overcome the difficulty of re-loading Burdan primed cases by drilling a 3<sup>rd</sup> hole in the centre of the primer pocket and subsequently use Boxer primers.

This is not recommended as creating a 3<sup>rd</sup> hole will more than double the backpressure on the primer and could potentially cause a blowback. I believe he saw sense.

### Bullet Heads

These are the bullet heads that hopefully hit your target. There is a vast range of heads covering an almost infinite range of:

- Calibres – broadly speaking the diameter of the bullet (so why are .38S and .357M the same calibre?)
- Weights – for each calibre there is a broad range of bullet weights from which to select.

- Type – again each manufacturer produces a range with different lengths, profiles and characteristics.

There are many types of head available including:

- Lead – only suitable for low velocity bullets (<1,500 fps) as the higher temperatures and velocity of a modern rifle would cause excessive lead deposits in the barrel. Lead bullets are commonly used in pistol calibre rounds or when downloading full bore rounds such as a .762/.308 when a .30 cal lead head is used.
- Jacketed – typically a lead core partly or wholly encased in a copper jacket. This overcomes the problems of excessive deposition when using a high velocity rifle. These heads may also have a polymer tip to improve their ballistic characteristics.
- Expanding – these are for hunting, they are designed to expand in a controlled manner on impact to ensure that the animal is brought down and not merely wounded. Only shooters who are authorised to hunt (pest control / stalking) will have their FAC endorsed to permit the purchase and use of these bullets.

There are many different profiles of bullet and this profile affects the aerodynamic efficiency (Ballistic Coefficient) of the bullet in flight. For general target shooting with a high velocity rifle many shooters choose a “Boat Tailed” design.

Most Pistol Calibre rifles use a tubular magazine in which the bullets are aligned and touching nose to primer under pressure from a spring. Do not use pointed or rounded heads as the bullet nose may apply sufficient pressure to detonate the primer of the round in front. The resultant chain reaction is almost certain to cause death and injury.

Bullet heads for use in such a gun should be flat in order that the nose does not apply pressure solely to the primer, rather the pressure is distributed across the base of the case. It is also imperative to ensure that primers are properly seated otherwise even a flat nosed bullet could detonate a primer.

## **Dangerous Ammunition**

For target shooting only ammunition that complies with the range certificate, or regulations, in terms of Muzzle velocity, Muzzle Energy and Calibre are permissible.

For shooting live quarry ammunition must comply with the relevant legislation (e.g. Deer Act) and landowners terms and conditions.

## **Hand Loaded Ammunition**

The principal dangers which may endanger the shooter or other are generally related to excess pressure caused by:

- Inappropriate powders.
- Inappropriate loads.
- Inappropriate components.

Common causes may include one or more of the following:

- Use of a too fast burning powder.
- An excessive charge.



- Over length cases which have not been trimmed causing the bullet to be crimped.
- Use of old / damaged cases which may rupture.
- Bad loading practices.
- Incorrect seating depth.
- Incorrect ammunition for the chamber dimensions e.g.
  - Use of .308 ammunition / loads in a 7.62 x 51 NATO chambered rifle.
  - Use of 5.56 x 45 ammunition in a rifle chambered for .233 Remington.

Signs of high pressure may include:

- Extraction problems that only arise with hand loaded ammunition.
- Marks on the case head caused by metal being sheared off and often resulting in extraction problems.
- Damaged primers.
- Gas leaks around primers.
- Case head failure.

## What Equipment Do I Need?

As if the components aren't varied enough the tools can be even more daunting. This section provides an overview of the equipment you may need.

### Press: essential

A press is required to:

- De-Cap - remove the spent primer, but not Burdan type cases.
- Re-Size - return the case to appropriate dimensions.
- Seat – set the bullet head into the case to the required depth.

Additionally the press may be used to insert new primers, insert the main charge and apply a crimp if required.

There are several types of press:

- Hand Press – more of a curiosity; seldom used but this press allows the assembly of a round without a workbench e.g. can be used in the field.
- Single Station Press – bench mounted and the relevant dies are inserted for each stage of the re-loading process.
- Turret Press – typically used for pistol calibres; the turret can hold several dies and rotates with each stroke to facilitate a different stage of the process. Optional add-ons can transform the basic turret press into a mass production platform churning out hundreds of rounds per minute. My personal concerns regarding use of turret presses are expressed later.

Be sure to clear extracted primers from around the press. I didn't understand why my primers weren't seating properly until I found a mangled primer was preventing the ram from fully descending.

**N.B. Be sure the press will accommodate the longest length case you expect to re-load.**

## **Dies: essential**

Reloading dies typically come in sets and are produced by various manufacturers, you will encounter

- Full length Sizing Dies; designed to de-cap a spent round and return the case to manufacturers tolerances. Essential if using second hand brass that has been fired in another gun.
- Neck Sizing Dies; designed to de-cap a spent round and re-size the neck to accept a new head, it is assumed that you are going to re-use the new round in the gun that fired the original round. Fine if the re-loaded round is to be fired in the same gun.
- Seating Dies - essential; designed to accurately seat the head into the case to the required depth.
- Charging Dies - optional; typically used with pistol calibres to allow a powder dispenser to charge the case during the reloading process.
- Crimp Dies - optional; used to improve the grip of the case on the bullet head and hence improve combustion characteristics. These are often part of a pistol calibre reloading set but can also be bought separately for rifle rounds.

Always follow the manufacturer's instructions when setting up the dies in your press.

## **Case Lube: essential**

Special oil that is thinly smeared on a case that is to be full length re-sized. Too much lube and the hydraulic pressure will buckle the case; forget the lube and the case will get jammed in die. You will need a hammer and drift to get it out. The Die manufacturers notes will advise whether lube should also be used when neck sizing, but it is essential for full length sizing.

## **De-Priming Tool: Burdan Cases Only**

Because a Burdan case has the anvil in the primer pocket and no central flash hole it cannot be de-capped using a standard reloading die. Burdan type cases require a special tool to remove the crimped in primer. Hydraulic water presses are also available for this task.

## **Priming Tool: Optional**

This is a separate hand held tool that can be re-used to prime cases after de-capping. It is an alternative to using the press for the priming operation.

## **Case Cleaning Equipment: essential**

Traditional case cleaners are a vibrating container filled with a cleaning medium (walnut shell). Used cases are placed in the cleaner and are scrubbed clean. These items are noisy and if used indoors the vibration will be felt throughout the house, I keep mine in the garage and try to avoid upsetting the neighbours, yes they are noisy.

Some people attempt to improve the performance of the case cleaner by adding a capful of "T Cut", this appears to work but you can find that one or two cases have a grungy plug of shell and T Cut which has to be raked out.

Make sure any residual cleaning media is removed from the case before using the press. Personally I always DE-Cap / re-size before cleaning as it was then easier to prick out any remnants of cleaning media.

A more modern approach is the Ultrasonic cleaner in which the cases are placed in a water bath and to which cleaning additives (Sea-Clean) may be added. The Ultrasonic cleaner is very effective, fast and relatively quiet. It will clean deposits from both inside and outside of the case. Remember to thoroughly rinse and dry the cases before re-loading.

Personally I prefer the Ultrasonic approach; these units are cheaper than traditional cleaners and can be purchased from places such as Maplin.

I also use the Ultrasonic cleaner to clean my long reflex moderators by:

- Standing a pint beer glass in the bath of water.
- Putting warm water, cleaning solution and the moderator in the beer glass.
- Running a cleaning cycle; when you lift the moderator you will be surprised at what falls out.
- Turning the moderator over and repeating the process. Brilliant!

Some people claim to get superb results with chemical cleaners or simply tying a load of cases in a cotton sack and putting them in the washing machine.

I haven't tried either of these approaches and I don't think my wife would be keen on the later.

### **Scales: essential**

Re-loading powders are measured in tenths of grains (7,000 grains = 1 pound). You will therefore need better than the kitchen scales:

- Simple re-loading beam balance scales will weigh up to 100 grains in 0.1 grain intervals, some will go higher.
- More sophisticated scales incorporate powder dispensers.
- Electronic scales are also available and the "tare weight" feature can remove the aggro of deducting the weight of the pan.

I have both beam balance and electronic scales which I routinely use to cross check each other so as to ensure accurate loads to within 0.1 grain.

As with anything, you get what you pay for. That said my electronic scales only cost £15 on the internet, weigh to 1/10<sup>th</sup> grain accuracy, weigh up to 1,500 grains and the tare function (reset the zero allowing for scale pan) makes them easily useable. I use a stainless steel cup from a hip-flask as the scale pan.

### **Powder Dispensers: recommended**

Most re-loaders use a powder dispenser which is adjustable to dispense a given volume of powder. Published data provides the approximate weight per unit volume of re-loading powders and this may prove sufficiently accurate when used with a standalone dispenser or a dispenser that is integrated with a turret press charging die and you are not pushing the safe upper limits.

Many re-loaders use the volumetric dispenser to deliberately provide a slightly light measure and then use a "Trickler" and scales to bring the charge to a precise weight.

### **Trickler: recommended**

The Trickler is a simple device, basically a powder hopper with a screw threaded tube going through the reservoir, turning the handle enables individual granules of powder to be added to the weighing pan enabling accurate loads to be produced.

### **Powder Funnel: recommended**

Unless you are using the powder dispenser integrated with a turret set (pistol loads), or relying on a volumetric dispenser you will need a Powder Funnel, this is an inexpensive plastic funnel enabling the transfer of powder from the weighing pan into the case without spillage. The design of the funnel enables it to be used with a broad range of case neck diameters up to .45 calibre.

### **Re-loading Block: essential**

It is a good idea to keep your cases in a controlled environment. To achieve this many re-loaders use a re-loading block which will hold up to 50 cases. Re-loading blocks can be purchased or easily made.

My own was made from two pieces of 15mm MDF, one piece being marked out and drilled to provide a 5 x 10 matrix of 10mm holes and then glued on to the 2<sup>nd</sup> piece creating a block with flat bottomed holes in which cases can stand without falling over. Cases can be placed in the block between re-loading stages and this encourages a methodical approach, enabling each stage to be visibly completed and checked.

### **Reloading Bench**

Some people have the luxury of a dedicated bench area for reloading, I don't!

My re-loading press is robustly mounted in a corner of the garage, all other activities take place on my reloading board; a 2' x 1' piece of 18mm ply, with a raised edging to prevent things slipping off, which I can use anywhere.

### **Micrometer: essential**

A critical aspect of re-loading is overall length. Digital micrometers are now cheap and facilitate easy measurement of overall length to a 1/2 thousandth of an inch without the complication of vernier scales. Have a look in budget supermarkets such as Aldi or Lidl, you could save £60.

### **Priming Tools: recommended**

Many presses come with a tool for inserting primers e.g. the turret press de-caps on the down stroke and allows primers to be inserted on the downstroke of resizing.

Alternatively many re-loaders prefer to undertake re-priming as a separate activity using a hand held re-priming tool. Take your pick.

### **Kinetic Hammer: essential**

A tool for dismantling a loaded cartridge; the hollow hammer head is a very strong plastic with a collets to grip the base of case. The hammer is firmly struck against the workbench, the head will gradually fall free and the charge will drop out behind it.

Sooner or later you'll need to make a bullet safe by dismantling it, this may be following a misfire or because you suspect the powder charge has been omitted.

Alternatively, one day you will re-load a cartridge and either forget to put in the primer or find the primer is standing proud; are you seriously going to try and re-prime after charging and head seating?

**I hope not!**

## Chronograph: Optional

A device for measuring muzzle velocity; not essential when you are working to published data but invaluable if you really want to get the best out of your re-loads, or need to prove compliance with range specifications.

## Case and Chamber Measurement Tools: Optional

These are more advanced re-loading tools and will be discussed later.

## Case Preparation and Maintenance

The case is the component that bears the brunt of the pressures associated with shooting and should therefore be carefully prepared. Remember that a case cannot be re-loaded ad infinitum; it has a limited life and you must check to ensure it is still safe to use. The commonly accepted wisdom is that neck sizing results in less wear and tear hence providing longer case life.

## Case Inspection

The essential first step is Case Inspection

- Discard any case with splits around the neck and badly dented cases. These can split when fired and cause hot gases to blowback through the breech.
- If you buckle the shoulder of the case during the reloading process discard these as well. They can jam in the chamber and rupture when fired which will also cause the hot gases to blowback.
- Also, because the case stretches every time it is fired the brass near the head of the cartridge becomes thinner, this is indicated by a bright shiny line around the case. DO NOT use any case displaying this characteristic. It will separate on firing and try to get down the barrel with the bullet. This will push your breech pressures up and could burst the gun.

## Case Re-Sizing

When a round is fired from a gun the case is fire formed by heat and pressure such that it becomes a perfect fit in the chamber of that gun. Even consecutive guns off the same production line will differ in chamber size due to manufacturing tolerances and hence a perfect Fire Formed fit in gun "A" will be oversized and will not chamber in gun "B". To overcome this problem you must, if using brass provided by a friend or new brass, undertake Full Length Resizing to ensure the case is to industry factory specifications (SAAMI).

Once you have fired the resized brass, or factory, ammunition in your gun it becomes a perfect match for you chamber. If you only intend to re-use the case in the same gun you may find neck resizing a better alternative.

If you have two guns of the same calibre you must either:

1. Maintain separate batches of cases for each gun, or
2. Full Length Size all ammunition so it is interchangeable.

N.B. See comments on ammunition tuning.

### Full Length Sizing Die

Typically the Full Length Sizing Die performs the following operations:

1. Punches out the used primer.
2. Returns the body of the case to industry specifications.
3. Resizes the neck to provide a firm grip on the bullet.

#### **N.B. Case Lube is essential**

As the Full Length Sizing reshapes the body of the case it is essential to use case lubricant otherwise the case becomes jammed in the die.

### Neck Sizing Die

The neck sizing die does not reshape the body of the case which has been fire formed to the gun. It merely:

1. Punches out the used primer.
2. Resizes the neck to provide a firm grip on the bullet.

#### **N.B. Check Die instructions, Case Lube may be required.**

### Primer Socket Cleaner

If the primer socket needs cleaning, a hand held reamer is available for this purpose.

### Case Length Trimming: recommended

In use, the heat and pressure causes the case neck to stretch, if this excessive you will not be able to chamber the re-loaded case. Tools are available to return the case to the correct overall length by cutting back metal from the case neck these include:

- A simple hand held arrangement which can also be used in conjunction with an electric drill to quickly bring the case back into specification.
- More elaborate mini lathes which do the same function.

### Case Neck Chamfering: essential

Having trimmed a case back to length the neck will have a square profile. Again simple hand tools or mini lathes are available to provide the appropriate internal and external chamfer.

### Choosing the Load

What weight bullet to use, what brand of powder and how much, what Overall Length. These are all question to be addressed when re-loading and there is no simple answer.

### What Bullet

Specifically type and weight are the issues and it is necessary to know the manufacturing specification of your gun.

A light bullet can be shot faster but is more prone to wind drift. A heavy bullet is less susceptible to wind drift but requires a tighter twist rate in the barrel to stabilise in flight. My .223 loading data covers a range of bullets from 32 grain to 80 grain; however my rifle has a relatively lazy twist and becomes inaccurate above 55 grains. Hence I tend to use either 40 or 52 grain heads.

## What Powder

If I were a perfectionist I would seek the ideal powder for each bullet. However, having studied the re-loading data I find that for me; v-N133 can be used for both heads, guess what I use?

It is interesting to note that the reloading data offers both vN133 and vN120 as suitable powders for my favourite load. Do not be tempted to mix these powders as they have significantly different reactions. Use one or the other, **never** mix powders.

## Data and Performance

Re-loading data is available from many sources; powder manufacturers obviously advertise what their own powders can be used for whereas manufacturers of dies such as LEE publish data for a range of powders. These data sheets provide a wealth of essential information, for example the LEE data includes:

- A range of bullet weights and types. For each of which is provided.
- Suitable powders
- Starting Load – a safe place from which to develop your loads.
- Volume CC – A means of translating between weight and volume of the Start Load.
- Auto Disk – how to set up the LEE autodisk dispenser, if you want to use one.
- Lee Dipper – which of the standardised dipper spoons to use, an approximate measure.
- Never Exceed – the maximum weight that you must never exceed.
- Velocity – The expected velocity achieved with the Never Exceed load.
- Minimum OAL – this is the minimum length from the base of the case to the point of the bullet. It varies with different powders and heads. Now there's a surprise!
- Maximum OAL – the maximum distance from base of case to point of the bullet

The LEE data I use for .233 Remington using 42 grain head and v-N133 specifies:

- Start Load 25.0 grains
- Never Exceed 26.8 grains
- Min OAL of 2.075"
- Max OAL of 2.260".

Somewhere between these is the right answer, but more of that later as it is trial and error.

## How Do I Do It?

The tools mentioned above will come with instructions on how to set them up and use them.

If you have any problems in setting up and using the equipment seek advice from all of:

- The associated instructions.
- The manufacturer's website.
- An authoritative reloading source.
- An experienced re-loader.

Or go on a Re-loading Course. These are provided by bodies such as BASC, the NRA or advertised in the shooting press.

As intimated above the turret press provides a semi automated environment for producing rounds in much the same way as factory producer. However, you will not have in place the same quality controls as used commercially.

I and colleagues have encountered a variety of problems with using turret presses. I still use the turret press but have removed the automatic indexing shaft in order to use it in single stage mode. Problems encountered include:

- Primers being inserted the wrong way up.
- Finished rounds with protruding primers due to blockages in the press. Potentially lethal with tube magazines.
- Blockages in the powder dispenser resulting in cartridges with a primer but no or insufficient charge.

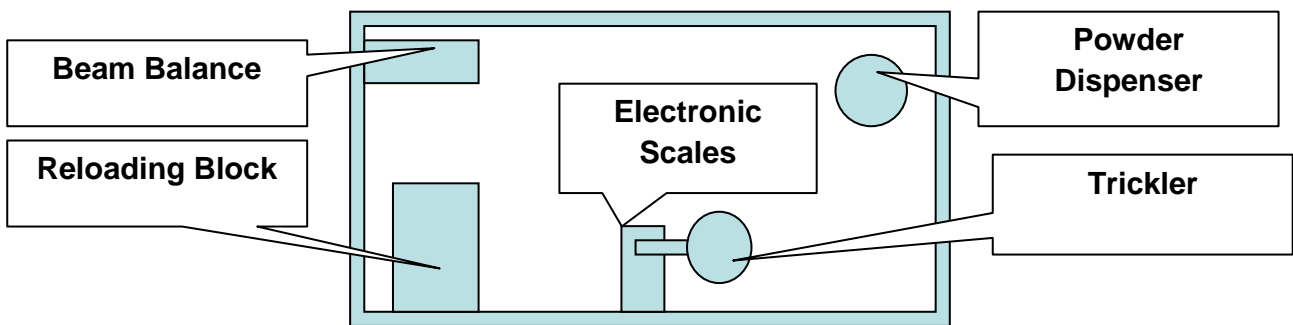
As should be apparent, I do not like semi automatic methods and now prefer to work through the process stage by stage. When re-loading it is important to:

1. Have a methodical process; doing things ad lib leads to omissions and problems.
2. Have a clear head; if you are anxious, have had a drink or argument you are in no fit state to re-load. You need to be alert and perceptive.
3. Have a comfortable working environment; set up your re-loading bench in the garage or a spare room, don't work on the edge of the breakfast bar unless everyone is out.
4. Get organised; I don't mean neat and tidy, I mean get all the things together that you will need. If you have to pop out for something you will introduce confusion and may forget something, maybe forgetting to put powder in a case.
5. Don't smoke or work near naked flames, things may go boom.



My own process is:

- De capping and re-sizing of spent rounds is done in the garage.
- Trimming and chamfering, if appropriate, can be done anywhere.
- On the odd occasion I use a vibratory case cleaner this is also done in the garage.
- Ultrasonic cleaning is done on the kitchen windowsill.
- Re-priming can be done in the garage with the press or by the fire with a hand primer.
- Charging is done on the reloading board laid out as below:



- Seating is done back in the garage.
- Finished rounds are stored in the safe.

In detail, I:

1. **Make sure the powder dispenser is clean, it may contain traces of pistol powder from a previous re-loading exercise and I don't want to cross contaminate my powders.**
2. Make sure I have the right cases, primers, powder, heads and dies for the current project.
3. Set up the press in accordance with manufacturer's instructions and position for de-capping and Full Length or Neck Only Re-sizing as appropriate.
4. Check each case and discard any that are dodgy e.g. cracks in neck.
5. Re-sizing, I always size a spare case that will be used to make a **reference round**.
  - a. If Full Length re-sizing, sparingly apply case lube, then Re-size and De-Cap.
  - b. If Neck sizing, Re-size and De-Cap
  - c. Check to ensure the bullet is tight fit, if you can slide it in by hand something is wrong.
6. Clean cases.
7. Make sure there is no cleaning media residue left within the case and check the flash hole is clear, place neck down in the re-loading block.

8. Case length trim and chamfer if appropriate, replacing each case neck up in loading block.
9. Put the **reference round** to one side as it is **not** to be primed and charged.
10. Re prime each case and place neck down in loading block.
  - a. Visual inspection to ensure each case is primed correctly; primers can flip and go in upside down or may not be seated properly, hence importance of placing neck down.
11. **If charging Pistol Calibre Cases**
  - a. Set up the dispenser for through the die charging and check correct weight is thrown.
  - b. Charge each case and return to loading block neck up so as not to spill powder.
  - c. Check 1 in 10 loads using scales to ensure accuracy, if problems are found resolve then and start again.
  - d. Visually check each case to confirm **they all contain the same depth of powder.**
12. **If charging Rifle Cases**
  - a. Set up standalone dispenser to throw a load that is consistently 2 or 3 grains light.
  - b. For each case:
    - i. Dispense a charge into the scale pan and place on scales
    - ii. Use trickler to bring charge up to desired weight
    - iii. Charge the case using powder funnel and return to loading block neck upwards so as not to spill powder.
    - iv. Visually check each case to confirm **they all contain the same depth of powder.**
13. Change press to Bullet Seating Die.
  - a. Back off the seating depth, insert a head into the **reference round** and seat the head to create an overlong cartridge.
  - b. Measure the OAL and compare to the re-loading data:
    - i. If too short use kinetic hammer to pull the head and then reset seating depth; repeat until overlong round is created.
    - ii. If too long increase seating depth
  - c. Adjust the seating depth until the **reference round** is correctly seated to the required OAL.
14. Now insert a charged case and bullet head.
  - a. Seat the bullet and remove the completed cartridge.
  - b. Repeat for the remaining cartridges.

- c. Double check the OAL for a sample e.g. every 10<sup>th</sup> case against the **reference round**.
15. Package and label completed rounds with date, charge and bullet weight and OAL.
16. Remember you have now made a batch of live ammunition which must be kept in your ammunition safe. You also have a **reference round** for the next re-loading exercise.
17. Empty any unused powder in the dispenser back into the **correct** container and ensure **no residue** is left in the dispenser.
18. Clear up any spilt powder with a dustpan and brush, dispose of safely, **do not attempt to re-use**. **Never** use a vacuum cleaner as sparks could ignite powder. **Try explaining that to your insurer!**
19. Clear up and have a brew.

## The Variables

This section assumes that you are trying to improve accuracy which is best defined by a tight group. If the group is not in the bull, then so what, you can always move the sights to put it there.

Remember there are two variables i.e. weight of powder and OAL. Changing one can affect the optimum value for the other so you need to keep on testing various combinations until you find Utopia.

## Working up the Load

As mentioned earlier the re-loading data provides a starting load and a maximum load. If only one figure is provided you need to assume this is the maximum load and take the start load as 10% less.

Make up batches of 3 or 4 rounds of ammunition beginning with the start load. In the above .233 example I would make batches at 0.3 grain intervals from 25 to 26.8 grain.

1. Starting with the 25 grain batch I shoot a group at 100 yds and measure the group size.
2. After each round I check for signs of excess pressure e.g. blowback or displaced primer.
3. I repeat this exercise for each batch stopping immediately if there are signs of excessive pressure.
4. From the batches that did not cause excessive pressure I choose the one that produced the optimum group.
5. If desired I can repeat the exercise centring on the above optimal load with 0.1 grain variations.

## Overall Length

The re-loading data provided for an overall length for .223 between 2.075" and 2.260".

Adopting a similar method as used to work up the load we can experiment with different OALs to find an optimum length.

## Tuning

The approach used in re-loading data for OAL is a relatively crude, but safe, measure from cartridge base to the point of the bullet, in reality it is futile as the point of the bullet is suspended in the barrel and different bullets have different curvatures. A more meaningful measure of maximum OAL is from the base of the

bullet to the lands of the rifling. As each batch of bullets is subtly different we need a way of measuring the true length.

We do not want the bullet to actually touch the rifling; in fact we need the bullet to jump from the cartridge neck into the lands otherwise we create a dangerous pressure build up. However the length of this jump can be crucial. I have measured this distance on Factory Ammo and re-loaded ammo made to published specification and found instances of jump on my 25-06 to be 0.125" whereas a good figure for general shooting is deemed to be between 0.020" & 0.040"; some bench rest shooters go for much less. Serious ammunition tuning involves both load optimisation and optimisation of the jump distance. As stated measuring to the tip of the bullet is second best, you need to measure the distance from the base of a reference case to point at which the "Ogive" (curved frontal section) of the bullet touches the rifling, you can then construct a **reference round** that will give the desired bullet jump e.g. Actual distance - 0.040".

These techniques require very accurate measurement. It must be noted that bullet heads vary in curvature even between batches from the same manufacturer. The measurement and construction of the "**reference round**" should be undertaken for each new batch, design or make of bullet.

If you have difficulty closing the bolt on such a round you have probably made the rounds too long and you could blow your barrel if you force things. Possibly you have added rather than subtracted the clearance.

Do not attempt this level of tuning until you have become proficient in re-loading in accordance with manufacturers published data.

A further issue with this approach is that your utopian round could be too long for the magazine. Well unless you are prepared to load each utopian round individually you will need to compromise on a shorter OAL.

Special tools to facilitate these measuring exercises can be bought or easily made.

Hornady (previously Stoney Point) make a variety of tools for measuring chambers.

- Bullet Comparator – a device that attaches to your micrometer, various bushes are available enabling you to measure the OAL of a round to a fixed point on the ogive (curved surface) of the bullet. This is an alternative to measuring OAL from base to point and is considered to be more accurate.
- Head and Shoulders Gauge – used to measure case length from base to a datum on the case shoulder; it enables more precise full length sizing as the die can be set up to provide optimum headspace and minimise case stretching.
- OAL Gauge – used in conjunction with comparator, this device enables the chamber to be measured exactly such that you can then produce rounds which will have a precise jump before engaging the lands.

A home made alternative to the OAL gauge is

- Neck size a fired case; trim and chamfer as appropriate.

- Using a fine hacksaw cut 1 or 2 slots down the case neck, file off any swarf using needle files to produce a clean neck. Generally the bigger the calibre the more slots, trial and error I'm afraid.
- A bullet head should now be inserted into the neck and be held firm by the springiness of the neck, but should not be too stiff.
- Chambering this round causes the head to be pushed home by the lands of the barrel giving a precise interference fit. **Beware**; if the bullet is too tight in the case it may be deformed by the barrel lands and if too slack it may move, either of these scenarios give an inaccurate measurement.
- Remove and measure the round **with the Comparator**, deduct the desired clearance (say 40 thou) you now know your optimal bullet OAL. This process should be repeated for each batch of heads.

**Do not use this method without a Comparator; measuring from base to point is not as accurate as a Comparator and you could make over length rounds.**

## Testing your Home Loads

With any shooting, whether Factory Ammo or Re-loads we need to be aware of each shot, after we squeeze the trigger we should always ask ourselves:

1. Did it sound right?
2. Did it feel right?
3. Did it go where I intended?

Being aware of what you are doing and asking yourself these questions can avert a lot of problems.

- Too loud and too much kick; maybe an overload, I could have damaged the barrel.
- Too quiet, little kick and no hole in target; maybe I forgot to put in the powder charge and there could be a bullet stuck up the barrel. Time to unload, leave the range and check the gun.
- Too quiet, little kick but a V bull. Looks good but perhaps someone is shooting at the wrong target; no names, but I know someone with a propensity for hitting the wrong target. Bloody accurate mind you. Better check up the barrel!
- Feels and sounds OK but grouping is bad; maybe I'm a pathetic shot, maybe the load is not optimal, maybe the scope is loose.
- Feels and sounds OK with ½" group at 100 yds; I'm chuffed, go home, lock the gun stuff away and open a bottle of wine.

With Factory Ammo, assuming your gun is properly maintained you should be able to shoot a reasonable group. If the gun blows up in your face either the gun was not properly maintained, or the Factory Ammo was a faulty batch.

With Home Loads there is no such debate; you are responsible for your gun, you made the ammo hence the fault is yours alone. This is no consolation if you or other shooters have been killed or injured.

Remember, it is your responsibility to ensure that your ammunition complies with the range certificate and is suitable for the gun in which it is to be used.

If you have followed the guidance you should not have a problem, you will know to within the same tolerances, as for Factory Ammo, the muzzle energy and muzzle velocity of your product. You will therefore know that it is within the ammunition specifications for both your rifle and the range /land on which you intend to shoot.

## Other Sources of Information

1. Guidance on transportation of black powder and small arms ammunition is available from the HSE <http://www.hse.gov.uk/cdg/pdf/blackp.pdf>
2. Manufacture and Storage of Explosives Regulation (MSER) 2005; a useful document available from the BASC website, this document is periodically updated, so search the BASC site for MSER
3. Powder manufacturers publish re-loading data for their own brands which can be downloaded.
4. Equipment manufacturers also have downloadable information on setting up the tools they supply and general re-loading tables covering a range of powder manufacturers.
5. There are many re-loading pages on the internet; these tend to be knowledgeable amateurs like myself or experienced re-loaders. You may pick up some useful tips but they are not always authoritative. A useful guide is available at <http://www.black-powder.co.uk/Reloading.pdf> this is not just about black powder.
6. Re-loading manuals; these are more authoritative but don't rush into buying them. For basic re-loading the information from powder and equipment manufacturers should suffice. Try and borrow from a friend or browse in the library to ensure it is the one you want; they aren't cheap.
7. Ballistic Programs; special software addressing internal ballistics and/or external ballistics:
  - a. Internal ballistics programs can help experienced re-loaders improve the performance of their ammunition within the gun.
  - b. External ballistics programs assist in understanding trajectories and wind drift.
  - c. Ammunition manufacturers such as Federal provide free downloadable programs covering their entire range of factory ammo. This can be useful in giving you an idea as to how your re-loads should perform. It can also help you decide what gun to buy next based on its expected ballistic performance rather than how nice it looks in the shop.